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SPECIATION AND SYSTEMATICS OF THE
GEKKONID LIZARD GENUS *PHYLLODACTYLUS*
OF THE ISLANDS OF THE GULF OF CALIFORNIA

By

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ABSTRACT: The possible factors affecting the rate of speciation of *Phyllodactylus* of the Gulf of California are discussed. Six new species and five new subspecies of *Phyllodactylus* are described from the islands. An analysis of variation within and between the populations of *Phyllodactylus* inhabiting the islands is presented.

INTRODUCTION

The California Gulf islands have, during the past 60 years, received considerable attention from biologists and geologists. Many collections of plants and animals have been taken from the islands, yet certain groups of vertebrates have been neglected. Among these have been the nocturnal lizards of the genus *Phyllodactylus*. The first record of *Phyllodactylus* from the islands was by Van Denburgh (1922). From 1922 to 1960, 113 specimens of *Phyllodactylus* had been taken from the approximately 30 islands of the Gulf, a number too few to be very helpful in understanding the insular relationships of this difficult group of lizards.

Between 1960 and 1965 several expeditions visited the Gulf islands and as a consequence about 400 specimens of *Phyllodactylus* are now available for study. Among the expeditions which have been responsible for this noteworthy addition to the available samples of this interesting gekkonid group must be

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mentioned the Belvedere Scientific Fund expedition of the California Academy of Sciences in 1962, the "Sea of Cortez" expedition of the California Academy of Sciences and San Diego Natural History Museum, 1964, and the "Biology of the Insular Lizards of the Gulf of California" expedition, of which the author was a member, in 1964. Further, a few specimens of *Phyllodactylus* have been collected by individuals who have on their own visited one or more of the Gulf islands in recent years; the numbers of specimens taken have not been large.

Davis and Dixon, in 1961, and Dixon in a series of papers between 1960 and 1964 (1960a, 1960b, 1962, 1964a, 1964b) reported on those populations of *Phyllodactylus* inhabiting the mainland of Mexico and Peninsular Baja California. In the present report I am concerned primarily with the dispersal and speciation of the insular populations of *Phyllodactylus xanti*. However, two other species, *P. unctus* and *P. tuberculosus*, are currently recognized as inhabitants of the Gulf islands; their insular relationships will be reported on briefly in the text of this paper. With this report I conclude my studies of those populations of *Phyllodactylus* found north of the Isthmus of Panama.

ACKNOWLEDGMENTS

I wish to thank the following persons and institutions for making available to me specimens of *Phyllodactylus* from the islands of the Gulf of California: C. M. Bogert, American Museum of Natural History (AMNH); J. M. Savage, University of Southern California—Allen Hancock Foundation (AHF-USC); the late Norman Hartweg, University of Michigan Museum of Zoology (UMMZ); R. F. Inger, Chicago Natural History Museum (CNHM); L. M. Klauber, San Diego Natural History Museum (LMK-SDMNH); A. E. Leviton, California Academy of Sciences (CAS); G. S. Myers, Division of Systematic Biology, Stanford University (SU); K. L. Norris, University of California at Los Angeles (UCLA); A. J. Sloan, San Diego Museum of Natural History (SDMNH); E. E. Williams, Museum of Comparative Zoology, Harvard University (MCZ).

I also wish to thank the following scientists and students of the 1964 "Biology of Insular Lizards" expedition to the islands of the Gulf of California for their able help in securing specimens: C. C. Carpenter, R. F. Clarke, T. P. Maslin, D. W. Tinkle, C. J. McCoy, L. J. Bussjaeger, W. C. McGrew, O. Cuellar, and S. W. Taft. I am especially grateful to S. W. Taft, D. W. Tinkle, and O. Cuellar for their many hours they spent with me toiling among the northern islands of the Gulf in pursuit of these elusive lizards.

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HISTORICAL CONSIDERATIONS

Genetic and physical factors obviously have had a marked effect on the dispersion and speciation of reptiles among the islands of the Gulf of California.

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The same species may occur on neighboring islands, or have a disjunct distribution occurring on islands that are not adjacent to one another, or different species of the same genus may occur on neighboring islands. For example, *Sauromalus hispidus* is found on two islands of a northern chain of islands which lie in a north-south direction. These islands, beginning at the northern end are: Angel de la Guarda, Partida (N.), Raza, Salsipuedes, San Lorenzo (N.), and San Lorenzo (S.). *Sauromalus hispidus* is found on Angel de la Guarda and adjacent islets, and on San Lorenzo (N.) and (S.) but it is not known to occur on any of the three intervening islands. On the other hand distinct species of *Phyllodactylus* occur on most of the islands mentioned.

An analysis of the populations of *Phyllodactylus* that have been sampled from 25 of the approximately 30 islands of the Gulf suggests three stages of speciation: 1) fairly recent separation from a parental stock, there being little or no evidence that these recently isolated populations differ genetically (as inferred from their morphologies) from the parental population; 2) a long period of isolation from a parental stock giving rise to readily distinguishable populations (species level); and 3) an intermediate condition of the first two stages (sub-species level).

Geographical isolation has played a leading role in providing an opportunity for diversification of populations of *Phyllodactylus* to take place. Reasonably well understood are the genetic mechanisms involved in speciation. Not so well known, however, are the unique characteristics of the Gulf islands in providing a singular geographical environment in which speciation can take place rapidly.

DESCRIPTION OF THE ISLANDS

According to King (1959), the coastal ranges of Baja California belong to the Nevadan Orogeny of the Cretaceous Era. King indicates that the probable formation of the Gulf of California was during a strike-slip movement of the San Andreas fault, and subsequent faults related to the San Andreas system may have displaced the main mountain mass some distance to the northwest from the original fracture zone. This type of faulting, a rise to the west and a drop to the east along the fault line, easily could have created the present inundation of land underlying the Gulf of California. More recently Allison (1964) discussed the geology of areas bordering the Gulf of California and mentioned additional hypotheses concerning the origin of the Gulf.

King (*op. cit.*) indicates that there were several subsequent compressions of rocks in the coastal ranges during the Tertiary period. The two general climax periods of orogeny occurred near the middle of the Miocene and early in the Pleistocene.

There are indications that while there were great areas still inundated following the mid-Miocene deformation, the mid-Pleistocene deformation brought about a widespread emergence. This may account for the fossil shell beds atop

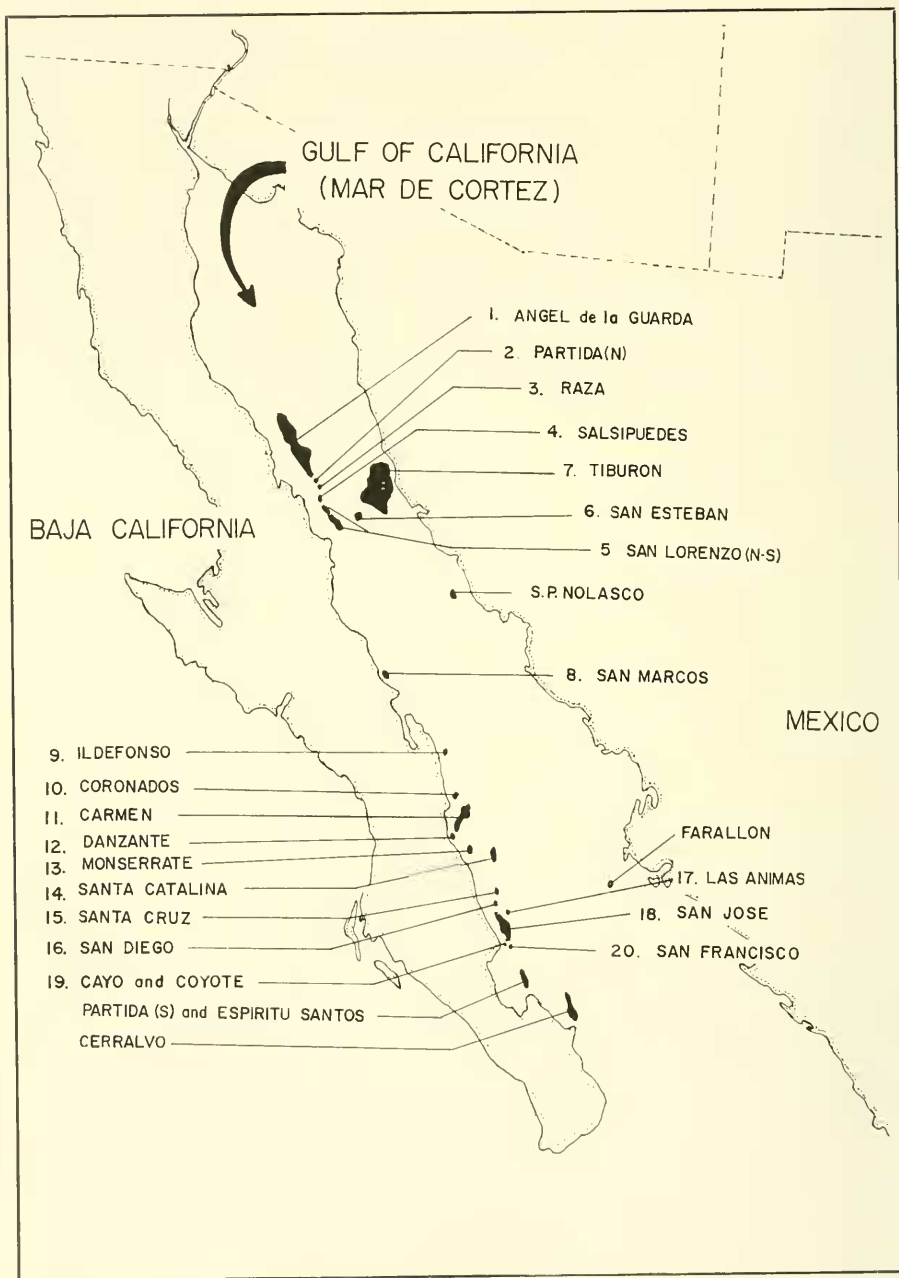


FIGURE 1. A map of the Gulf of California indicating the islands where *Phyllodactylus* have been taken. The numbers present before some of the islands correspond with the sequence of numbers found in figures 3 through 12.

some of the islands in the Gulf. These islands lying close to the peninsula of Baja California have probably been separated from, or united with, the peninsula several times during the late Miocene and early Pleistocene. There are fossil Pleistocene shell beds on nearly all of the islands, indicating a much higher sea level than found at the present time. There are fossil shell beds on the tops of Isla Partida (S.) and Espíritu Santo showing that those islands were once completely submerged. However, some of the islands do not appear to have shell beds; such beds, if present at one time, may have weathered away if the islands have been emerged for a long period of time, or the islands may never have been completely inundated. There is some doubt as to the exact time the Gulf islands were formed or when individual islands were either submerged or exposed. According to geologists W. E. King and J. I. Colbert (personal communication) there have been several periods of emergence and submergence associated with periods of fault activity.

A brief description of the geology, physiography, and vegetation of the islands is given by Lindsay (1962) in his account of the Belvedere Expedition to the Gulf of California. However, a few remarks about the physical distance of each of the northern islands from the Baja California peninsula and from the mainland of Mexico (State of Sonora), and from island to island, seem necessary for the purposes of this report.

Isla San Pedro Martir lies farthest out in the Gulf, about 22 miles south of Isla Tiburon, 32 miles east of peninsular Baja California, and 37 miles west of the Mexican mainland. *Phyllodactylus* has not been taken from this island, nor from Isla Tortuga, which is located about 16 miles NE. of Isla San Marcos, 22 miles E. of Baja California, and 81 miles W. of Sonora.

Phyllodactylus has been taken from all the remaining islands of the northern portion of the Gulf. Isla Tiburon lies 2 miles west of the Sonoran mainland. Isla San Esteban lies 8 miles west of Tiburon and 10 miles east of Isla San Lorenzo. Isla Salsipuedes lies 1 mile NW. of San Lorenzo and five miles south of Isla Raza. Isla Partida (N.) is located 8 miles SSE. of Angel de la Guarda and 7 miles NNW. of Isla Raza. The latter islands form a long chain in northern terminus lying 8 miles east of Baja California, the southern end 11 miles east of the peninsula. The island chain is surrounded by depths of water greater than 600 feet, while depth of the water between San Esteban and Tiburon and the Sonoran mainland is less than 600 feet. All of the remaining islands lie on the continental shelf of Baja California or of mainland Mexico with the exception of San Pedro Martir and Isla Tortuga. All of the southern Gulf islands lie within 14 miles of the peninsula of Baja California, and most lie within 4 miles.

Distance from island to peninsula or mainland or from island to island does not appear to be an important factor in determining the possible routes of dispersal in the Gulf of California. However, the combination of distance, depth of water, and present relationship of insular populations with those of the main-

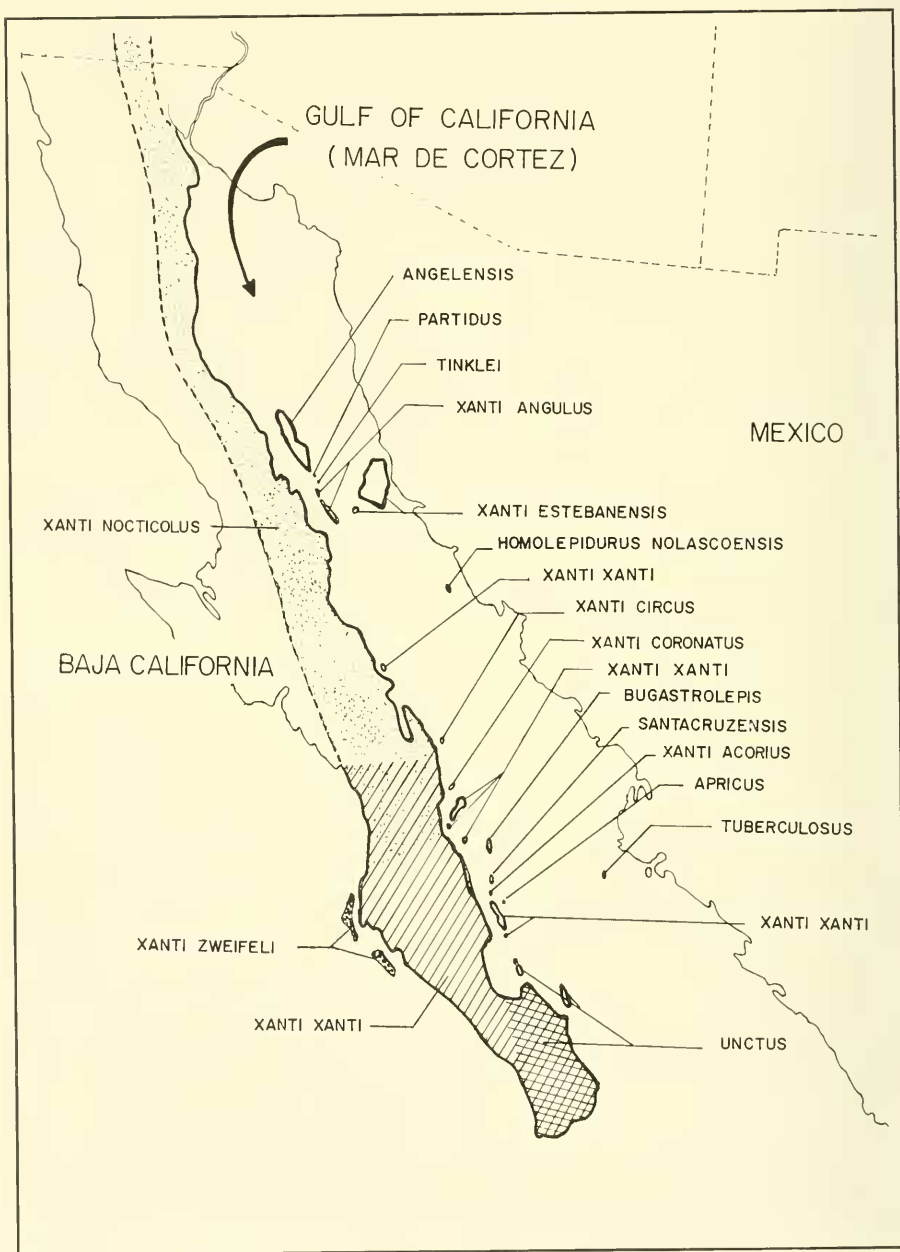


FIGURE 2. A distribution map of the species and subspecies of *Phyllodactylus* inhabiting Baja California and the islands of the Gulf of California.

land and/or peninsula does give some insight into the comparative recency that islands may have been connected with the mainland, with the peninsula, or to one another.

SPECIATION IN GULF ISLAND *PHYLLODACTYLUS*

The rate of speciation is affected by both genetic and geographical factors. Morphological characteristics of the various insular populations may be used as an index of genetic similarity between populations. The rate of speciation between island populations and between island and mainland or peninsular populations may be surmised. The rate of differentiation that one insular population may reveal over another is also suggested, but not the possible reasons why one population evolves faster or slower than another.

The following may serve as an example of the above: Islas Cerralvo, Partida (S.), Espíritu Santo, and Ballena are 4 to 5 miles from Baja California or from possible connections with other islands and the peninsula. The populations of *P. unctus* found on these islands deviate very little from that on the peninsula. Under the conditions outlined above, this form has shown little tendency toward speciation. However, Isla San Pedro Nolasco lies 9 miles from the Sonoran mainland; the population of *Phyllodactylus* inhabiting the island, though related to a mainland form, is quite distinct, and a rapid rate of evolution is suggested. The name presently applied to the San Pedro Nolasco population is *P. homolepidurus nolascoensis*. Recent additional material from the island indicates a longer period of isolation from the mainland than was originally believed (Dixon, 1964). An analysis of the additional material indicates that the characters that separate *P. h. nolascoensis* from *P. h. homolepidurus* are more uniform and diagnostic in nature. The Isla San Pedro Nolasco population may represent a distinct species, rather than a race of the mainland form.

NORTHERN GULF ISLANDS. The rate of speciation among the leaf-toed geckos of the Gulf of California islands appears to be most rapid in the northern portion of the Gulf. The populations inhabiting Angel de la Guarda, Partida (N.), and Raza appear to be more distinct, with the San Lorenzo-Salsipuedes and San Esteban-Tiburon populations more closely related to *P. xanti nocticolus* of peninsular Baja California. This is unusual inasmuch as Angel de la Guarda is much closer geographically to Baja California than is Isla Tiburon. I cannot explain this insular relationship on the basis of distances from island to island or from island to peninsula beyond calling the reader's attention to those factors. However, the factors mentioned in the historical section surely provide part of the answer.

The similarities of the Tiburon-Esteban population to that of peninsular Baja California may not be as close as the scale characters indicate. If we exclude the latter characters and consider color and color patterns, the relationship is reversed. The ventral color and dorsal color pattern more closely resembles

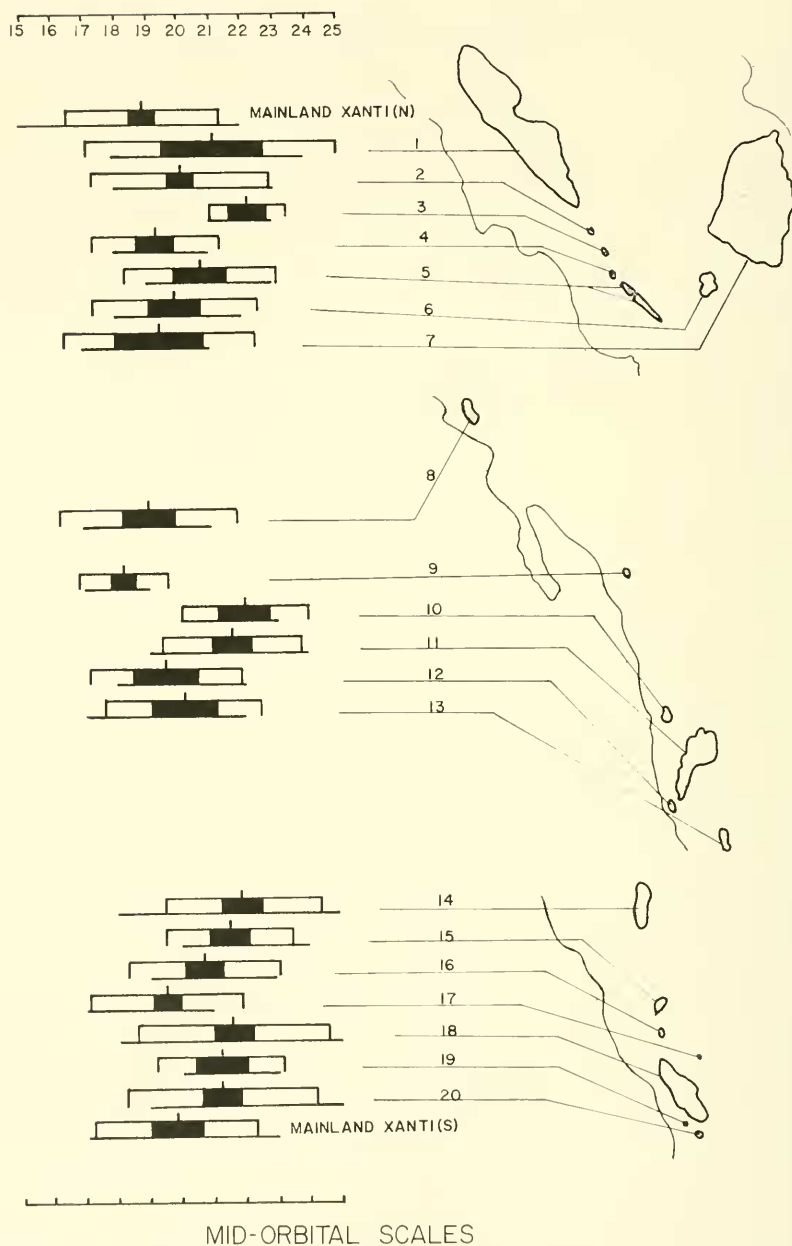


FIGURE 3. Variation in the number of mid-orbital scales of *Phyllodactylus* of the islands of the Gulf of California. Vertical bar represents the mean; open rectangle, twice the standard deviation; black rectangle, twice the standard error; bottom horizontal line, range of variation.

that found in *P. homolepidurus* of the Sonoran mainland. The question arises as to which one of the characters is the more reliable. All specimens of *P. xanti* exhibit more orbital scales than scales across the snout at the level of the third labial, and the reverse is true in all those of *P. homolepidurus*. On the other hand, all individuals of *P. xanti* have a white venter while those of *P. homolepidurus* have yellowish or dusky areas on the lateral margins of the belly. There are more external factors affecting color than those affecting the number of scales. Temperature and humidity frequently cause color changes in *Phyllodactylus*. The color of the *Phyllodactylus* on the eastern side of the Gulf in the vicinity of Tiburon and the Sonoran mainland may be exhibiting a phenotypic response to the environment. The population could also be one that has intergraded with or hybridized with *P. homolepidurus*, and the island population consists wholly of a hybrid population.

However, I believe that the scale characters should exhibit some intermediate condition between the two forms, and this condition has not been found. If the population is responding to phenotypic stimuli, and its true relationship is with *P. xanti* some 32 miles to the west, the resulting zoogeographic pattern of dispersal is confusing.

Isla Partida (N.) is inhabited by a population of *Phyllodactylus* that appears to be related to *P. homolepidurus*. This island is 12 miles east of Baja California and 20 miles west of the Sonoran mainland. This population is unlike its neighboring populations on islands 8 miles to the north (Angel de la Guarda) and 5 miles to the south (Raza), which resemble *P. xanti* in size and in some scale characters.

The islands are probably remnants of mountaintops of an ancient mountain mass once connected to Baja California that became inundated with the formation of the Gulf. A possible answer to the present distribution of *P. xanti* stock would be one of former distribution over the mountain mass prior to inundation. This would explain the relationship of the Tiburon population, but not the one on Partida (N.).

The Partida population may have arrived from Sonora by rafting and hence evolved from *P. homolepidurus* stock. There is the possibility of independent genetic drift of a *P. xanti* stock that just happened to evolve into a population resembling "*homolepidurus*" stock. In any case, the actual mechanics may never be demonstrated. The present fact is that it appears to be of "*homolepidurus*" stock, and I am obligated to treat the population on the basis of its apparent relationship to the Sonoran mainland species.

The populations inhabiting Islas San Esteban and Tiburon are similar in color, color pattern, and in all scale characters except in the number of scales bordering the internasals. The latter character is not statistically distinct and is not considered as a diagnostic feature for differentiation of the two island populations. I consider the two populations identical and of fairly recent origin. They

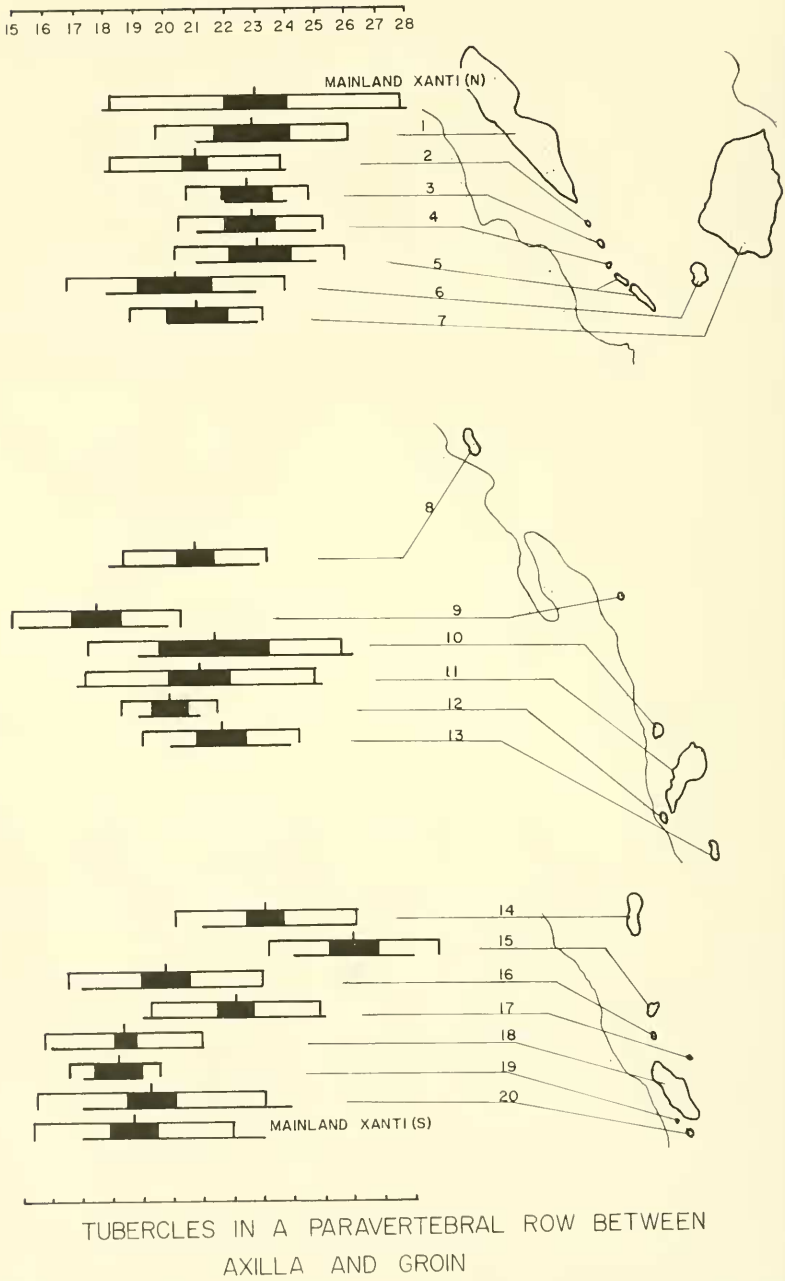


FIGURE 4. Variation in the number of tubercles in a paravertebral row between axilla and groin (see figure 3 for explanation of analysis).

are now sufficiently distinct from *P. xanti nocticolus* to be considered as a subspecies.

The populations occurring in Islas Salsipuedes, San Lorenzo (N.), and San Lorenzo (S.) are in about the same stage of speciation as the San Esteban-Tiburon populations. They are relatively close in all characters with the Salsipuedes population, indicating slight divergence in some scale characters from the San Lorenzo populations. However, they are statistically distinct from the San Esteban-Tiburon and the Baja California populations in several scale features. Color and color patterns are similar to those on Baja California rather than to the San Esteban-Tiburon population.

The dispersal route of the parental stock of *P. xanti* seems to be from Baja California to Isla San Esteban and Isla Tiburon via the islands of Salispuedes and San Lorenzo. I base this assumption on the present morphological relationships of the *Phyllodactylus* on these islands.

The Isla Raza population indicates a closer relationship to the Salsipuedes population some 5 miles to the south, than to the Partida population 7 miles to the north. However, the Raza population has evolved much further than the Salsipuedes population. Of 13 essential meristic characters analyzed in this study, the Raza population is statistically distinct from the Salsipuedes population in 6, from the Partida population in 9, and from mainland *P. xanti* in 5. Its relationship with the mainland is not as close as is indicated by its meristic characters for the color and color patterns are quite unlike the mainland *P. xanti* and adjacent islands.

The population inhabiting Isla Angel de la Guarda has apparently reached the advanced stage in speciation. It is statistically distinct from the Partida population in 9 of the 13 meristic characters, and in 8 from the mainland *P. xanti*. The color and color pattern is similar to that of *P. xanti* and quite unlike that of the Partida population.

The rate at which speciation has taken place among the populations inhabiting the northern islands appears to be out of balance. Three islands indicate that their populations have reached the species level while five islands, equally as far from the mainland, as large as some of the others, and with similar vegetation and climate, have differentiated theirs only to the subspecies level. The elements of time and distance may be involved for we do not know how many times in the past the islands may have been connected to the mainland and affected by reinvasion of the parental gene pool. We may surmise that some of the islands were connected to the mainland several times, while others were not, thus slowing the rate of speciation on some islands and increasing it on others. The possibility of any number of environmental changes may have taken place in the Pleistocene that altered gene selection through extrinsic stress upon any number of the islands' populations.

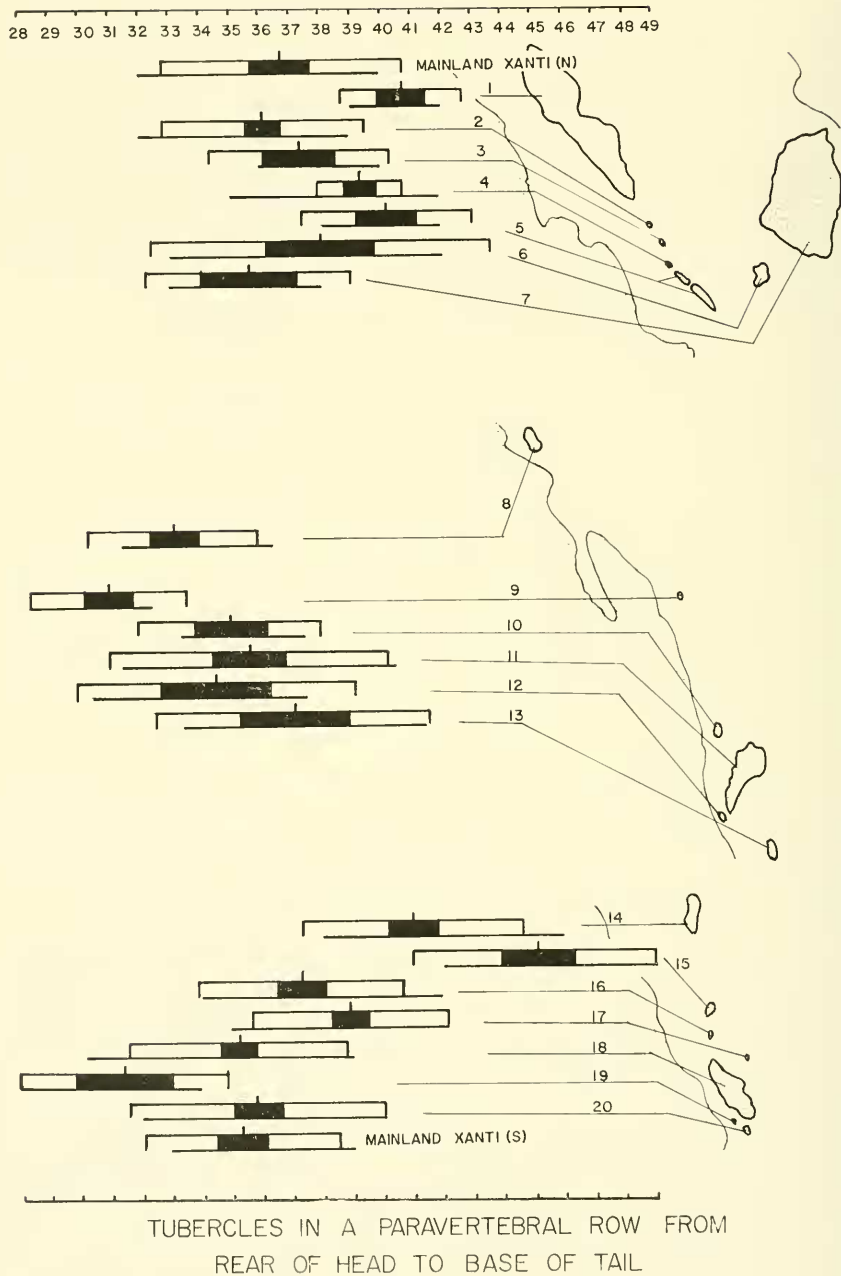


FIGURE 5. Variation in the number of tubercles in a paravertebral row from rear of head to base of tail (see figure 3 for explanation of analysis).

It is evident that changes of some kind did occur and the various populations were so altered in morphological features as to be unlike the parental stock.

THE CENTRAL ISLANDS. Isla Tortuga appears to be a recent island, lacking extensive vegetation and numbers of species of terrestrial vertebrates. The island is composed of basaltic lava, and steam fumaroles are still present. *Phyllodactylus* has not been found on this island.

Isla San Marcos is occupied by a population of *Phyllodactylus* that appears to be closely related to the Baja California mainland population of *P. xanti*. There appears to have been some recent gene exchange between the island and mainland populations, as indicated by their present morphology. The population differs from the mainland form in 3 of the 13 meristic characters analyzed, and further analysis of nonmeristic features indicates an early stage of speciation. The island population appears to have been connected to the mainland population in recent times. This may have been by rafting or land connection for the island is only 3 miles from the mainland of Baja California.

Isla Ildefonso lies 7 miles east of the Baja California mainland, and some 54 miles southeast of Isla San Marcos. The *Phyllodactylus* population occupying this island is closely allied to the San Marcos and Baja California mainland populations. The major meristic differences are found in the high number of tubercles in a paravertebral row from head to tail and between axilla and groin. Its apparent rate of speciation is slightly more advanced than that of the San Marcos population.

Two small islets in Bahía Concepción have populations of *Phyllodactylus* that indicate a close relationship to Baja California populations. However, there are only two specimens from each of the islets (Mosca and Coyote). Two specimens are not sufficient for an analysis of characters, and I have placed these specimens with *P. xanti xanti* until further specimens are available.

SOUTHERN ISLANDS. There are twelve major islands lying relatively close to the southeastern shore of Baja California. Three of these, Cerralvo, Partida (S.), and Espíritu Santo, were discussed previously. Some of the remaining islands have offlying islets that are inhabited by *Phyllodactylus*, and of the 12 major islands 9 have populations of *Phyllodactylus*.

The Isla Coronados population is statistically distinct from *P. xanti nocticolus* in the number of postmentals, scales across the snout at the level of the third labials, and scales across the head in the mid-orbital region. It differs from *P. xanti xanti* in the latter two counts, and in addition, the number of tubercles in a paravertebral row from rear of head to base of tail, and from axilla to groin.

The population differs from the Isla Carmen population, some 7 miles to the south, in the number of scales across the snout at the level of the third labials, scales across the venter, and longitudinal rows of scales of the venter. This population appears to be intermediate in its evolutionary history, and lies somewhere between stages two and three. I do not think that its relationship to the

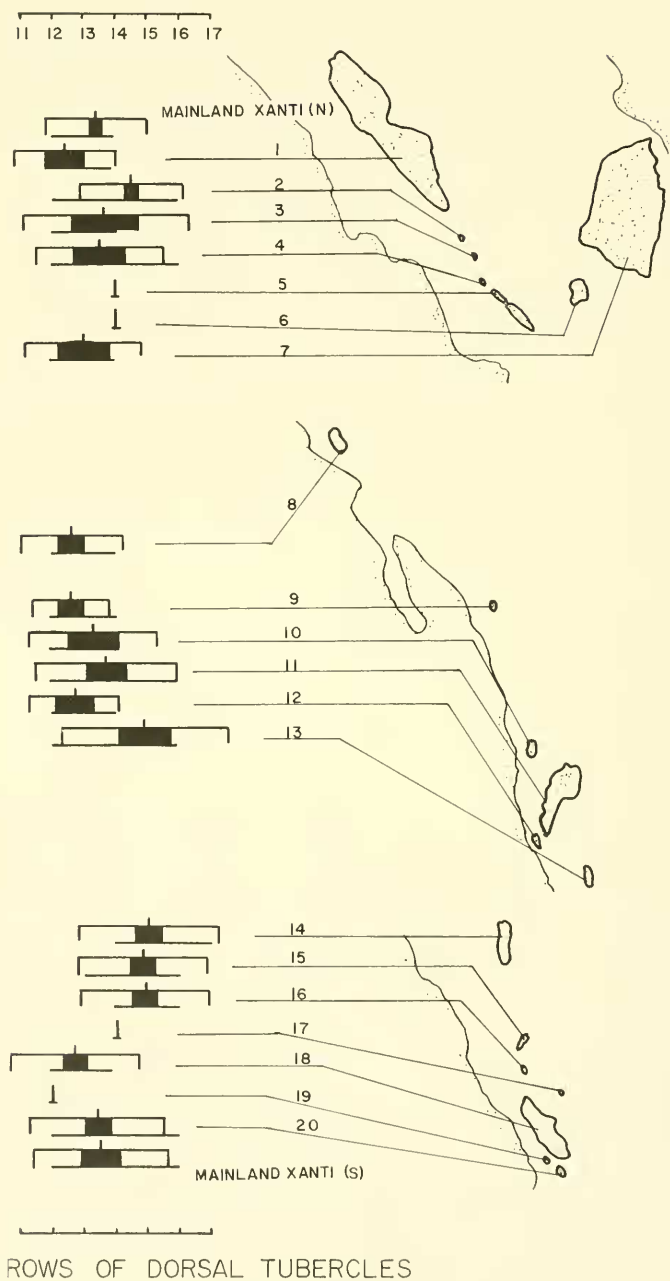


FIGURE 6. Variation in the number of longitudinal rows of enlarged dorsal tubercles (see figure 3 for explanation of analysis).

mainland population has proceeded much beyond the subspecies stage, yet it shows a certain amount of evolutionary divergence from other island populations.

The Isla Danzante population indicates little divergence from the mainland forms of *P. xanti*. It differs from *P. xanti xanti* in the number of tubercles in a paravertebral row from axilla to groin, and from *P. xanti nocticolus* in the number of scales across the venter. This island lies midway between Isla Carmen and the mainland, and the Isla Carmen population is statistically distinct from the Danzante population in the number of scales between the orbits and across the venter. If we compare the Carmen sample directly to the mainland sample, it deviates in such characters as the number of lamellae beneath the fourth toe, scales between the nostril and eye, between the orbits, scales bordering the postmentals, across the snout, across the venter, longitudinal rows of the venter, and number of tubercles in the paravertebral row from head to tail and between axilla and groin. This would seem to indicate that the Carmen population is quite distinct. However, the Danzante population is intermediate between the Carmen and mainland populations. It appears to me that the Danzante population is a hybrid one, and the mainland and Carmen populations were at one time joined across Danzante. I do not consider the Carmen population as having reached the subspecies level, even though the Carmen population appears distinct from the mainland forms.

The Monserrate population does not differ from the Carmen population in any character, even though it lies 11 miles to the southeast of Isla Carmen. I also find that the two populations are similar in color and color pattern. It is difficult to surmise that these two populations are identical, considering the distance separating the islands. However, until a sibling condition is proven to the satisfaction of all concerned, I find it necessary to retain the two populations as members of the same race.

Isla Catalina is the farthest from the mainland of the southern islands group. Its *Phyllodactylus* population differs from the mainland form in 5 of the 13 characters analyzed; from the Isla Monserrate population in 4 characters; and from the Isla Santa Cruz population in 8 characters. The Catalina population appears to be specifically distinct from the surrounding insular *Phyllodactylus* populations and from the mainland form.

A similar situation exists between the Isla Santa Cruz population and surrounding insular and mainland populations. The population differs from the Catalina *Phyllodactylus* in 8 characters, and from *Phyllodactylus* inhabiting Isla San Diego in 6 characters.

The San Diego population differs from the Isla San Jose *Phyllodactylus* in 3 characters, and from the mainland form in 3 additional characters. Its relationship appears to be closer to the San Jose population, but differs from the latter form in color and color pattern. The population seems to have reached the subspecies level but has not evolved beyond this point.

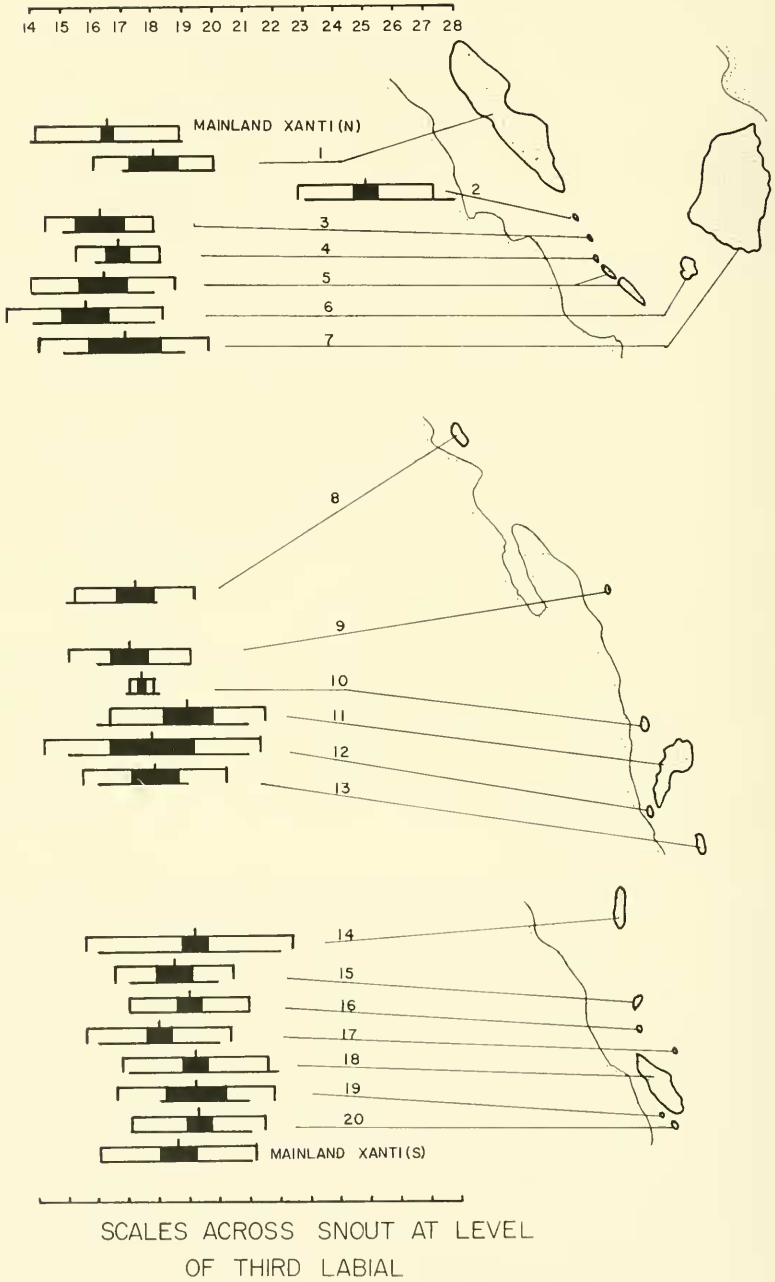


FIGURE 7. Variation in the number of scales across the snout at the level of the third labial (see figure 3 for explanation of analysis).

The *Phyllodactylus* populations inhabiting Islas San Jose and San Francisco appear to be identical in all scale characters, color, and color pattern. The two populations appear to be very close to the mainland form, with a slight deviation in 2 scale characters. Their relationship to the mainland form indicates a recent insular distribution, and I consider the insular populations as members of the mainland race.

Islet Animas, a small granite protusion situated 3 miles east of Isla San Jose, is remarkable in that it has a rather high population density of *Phyllodactylus*. The geckos of this islet deviate from the San Jose population in 8 of 13 scale characters. This amount of divergence from its apparent related stock of San Jose may be due to chance drift. The rate of evolution may have been increased by the relatively small size of the islet and a corresponding increase in gene flow between individual lizards. The islet is only a few hundred yards long and is several thousand times smaller than San Jose. It seems to be specifically distinct from the San Jose and mainland species.

ACCOUNTS OF THE INSULAR FORMS

Six new species and 5 new subspecies are described from the islands of the Gulf of California. All but one of these belong to the *P. xanti* complex of Baja California and the southern California area of the United States. The species inhabiting Isla Partida (N.) is considered as a member of the *P. tuberculosus* group of western Mexico, excluding Baja California. Two Gulf islands, San Pedro Nolasco and Farallon, also have populations of *Phyllodactylus* referable to the *P. tuberculosus* group. Farallon Island harbors a population of *Phyllodactylus* known only from one specimen. It appears to be closely related to *P. tuberculosus* of the mainland, but a study of more specimens will be necessary to assign the population to a species. *Phyllodactylus unctus*, *P. nolascoensis*, and *P. tuberculosus* have been treated in detail in an earlier paper (Dixon, 1964a) and that information need not be repeated here.

The mainland forms of *P. xanti* have been reported on in the latter paper, but the relationship of *P. xanti* to the insular forms is one of the essential parts of the present study, and much of the comparative analysis is included herein (see figures 3–12).

The variation in scale characters within and between the various insular populations is given in the figures following this account. A written statement concerning variation within this genus and its species is given in Dixon (1964a).

Phyllodactylus xanti xanti Cope.

For an account of the literature, diagnosis, and variation of this subspecies from the mainland of Baja California, see Dixon (1964a). Specimens of this race from Islas San Jose, San Francisco, Coyote, and Cayo differ from the mainland population in having slightly fewer scales across the venter, and fewer lamellae beneath the fourth toe, and in having more interorbital scales. The

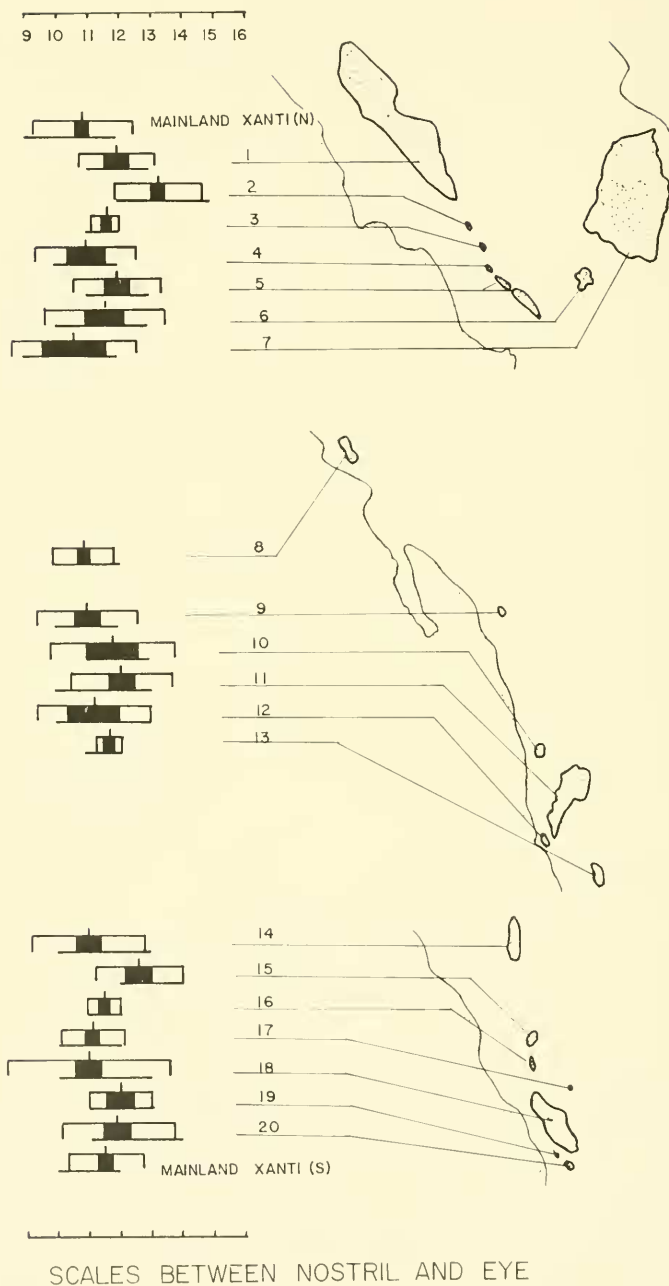


FIGURE 8. Variation in the number of scales between the nostril and eye (see figure 3 for explanation of analysis).

populations from Islets Coyote and Cayo deviate strongly in more features but are intermediate when compared with populations from San Jose and San Francisco.

The populations of *Phyllodactylus* inhabiting Islas Carmen, Danzante, and Monserrate are more closely allied to *P. xanti xanti* than to *P. xanti nocticolus*, the northern Baja California race. The presence of thigh tubercles definitely places these populations with *P. xanti xanti*. However, thigh tubercles are absent on southern island populations of *Phyllodactylus* on Las Animas, and northern populations on Angel, Salsipuedes, and San Lorenzo, but present on all remaining island populations.

Specimens from Isla Danzante are intermediate in all characters between mainland *P. xanti xanti* and the populations occupying Carmen and Monserrate. The Carmen and Monserrate samples appear to be distinct when compared directly to the mainland sample. However, when either population is compared with the Danzante sample there seems to be a cline in all characters.

RANGE. Islas Danzante, San Marcos, Carmen, Monserrate, San Jose, San Francisco, and islets Cayo and Coyote, Gulf of California.

SPECIMENS EXAMINED. (92). Danzante: SDMNH 44608, 50860–62; CAS 52167–68. Carmen: AMNH 65956; CAS 51873, 98506–17; SDMNH 44609. Monserrate: CAS 52307–09; SDMNH 44610, 50804–07; LMK 6832–33; San Jose: CAS 84847–53, 98496–501, 52702–03; SDMNH 50800–02, 50864–67, 44603, 44614–19, 44625–27. San Francisco: CAS 52749–54, 84848, 98502–05; MCZ 31518; SDMNH 44628–29, 50781–90. Cayo: SDMNH 44630, 50796–99. Coyote: SDMNH 50891. San Marcos: CAS 98518–29, SDMNH 50854–55.

Phyllodactylus xanti angulus Dixon, new subspecies.

HOLOTYPE. Adult ♂, CAS no. 98477, collected by James R. Dixon and Stanley W. Taft; from a granite boulder, August 19, 1964 Islas Salsipuedes, Baja California.

PARATYPES. Salsipuedes: CAS 51231–32, 98479–80; MCZ 82866; SDMNH 44677–78, 50868–69. San Lorenzo: CAS 51295; SDMNH 44238–39, 50856–59, 50833.

DIAGNOSIS. An average snout–vent length of 43.1 mm., differing from *P. xanti xanti* in having a significantly lower number of snout scales, lamellae beneath fourth toe, higher number of tubercles in a paravertebral row; from *P. xanti nocticolus* in having a significantly lower number of transverse belly scales, and higher number of tubercles in a paravertebral row.

DESCRIPTION OF HOLOTYPE. Rostral almost three times as wide as high, its dorsal edge with a slight depression at the mid-point; 2 internasals, triangular, their median edges in narrow contact, bordered posteriorly by 5 granules and the postnasal of each side, nostril surrounded by the rostral, labial, internasal.

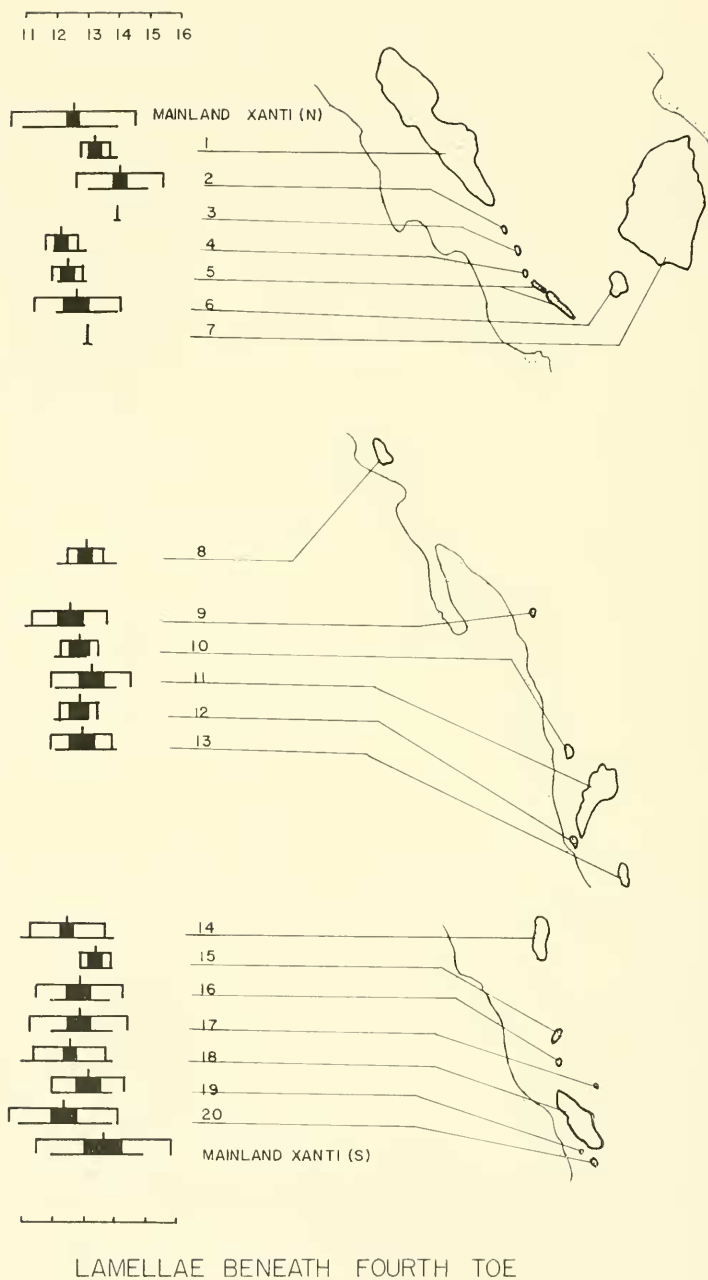


FIGURE 9. Variation in the number of lamellae beneath the fourth toe (see figure 3 for explanation of analysis).

and 2 postnasals. First supralabial in broad contact with ventral edge of nostril; a shallow depression between internasals, a moderate depression in frontal region; 11 scales between eye and nostril, scales in posterior loreal region about 5 to 6 times larger than scales in midorbital region; 17 scales across snout at level of third labials, 15 scales at anterior edge of orbits, 18 interorbital scales; eye large, its diameter contained in length of snout one and one-third times; eyelid with one row of granules and one larger outer row of scales; diameter of ear contained in eye diameter two and one-half times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 6 supralabials and 6 infralabials to a point below center of eye; mental bell-shaped, as wide as long; bordered posteriorly by postmentals; postmentals wider than long, their median edges in narrow contact, postmentals followed by transverse row of 7 scales, followed by second row of 12 smaller scales; postmentals contact only the first labial of each side.

Dorsum with 14 longitudinal rows of enlarged, keeled tubercles that are somewhat flat; paravertebral row with 39 tubercles from rear of head to base of tail, 23 between axilla and groin; paravertebral rows separated from each other by 4 to 5 rows of granules; 8 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 3 on each side, distinct; venter with 62 longitudinal and 33 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh without tubercles dispersed among the smaller flattened scales, lower leg with a few tubercles interspersed among the granular scales; lamellae formula for hand 7-8-9-9-8, foot 7-9-11-12-10; claw short, visible when viewed from below; terminal pad large, slightly truncate at tips; tail tubercular rows reduced to zero at third proximal tail whorl.

MEASUREMENTS (in mm.). Snout-vent length 46, axilla-groin length 21, length of leg 20, length of arm 15, length of tail 50, length of head 15, width of head 10.5, length of snout 5.0; diameter of eye 3.5, diameter of ear 1.4.

COLOR IN LIFE. Ground color gray, dorsum with 5 dark gray crossbands, broken medially; mid-dorsal line of dark gray from rear of head to pelvic region; snout reticulated with dark gray lines, top of head with minute grayish brown flecks; loreal stripe dark brown, short, from mid-snout to orbit; limbs ground color with a few scattered darker spots of brown; tail reticulated and spotted with grayish brown; venter cream white; white tipped tubercles not in evidence, but sometimes present in other specimens.

RANGE. Islas Salsipuedes, San Lorenzo (North and South), Gulf of California.

SPECIMENS EXAMINED. (19), listed under type and paratypes.

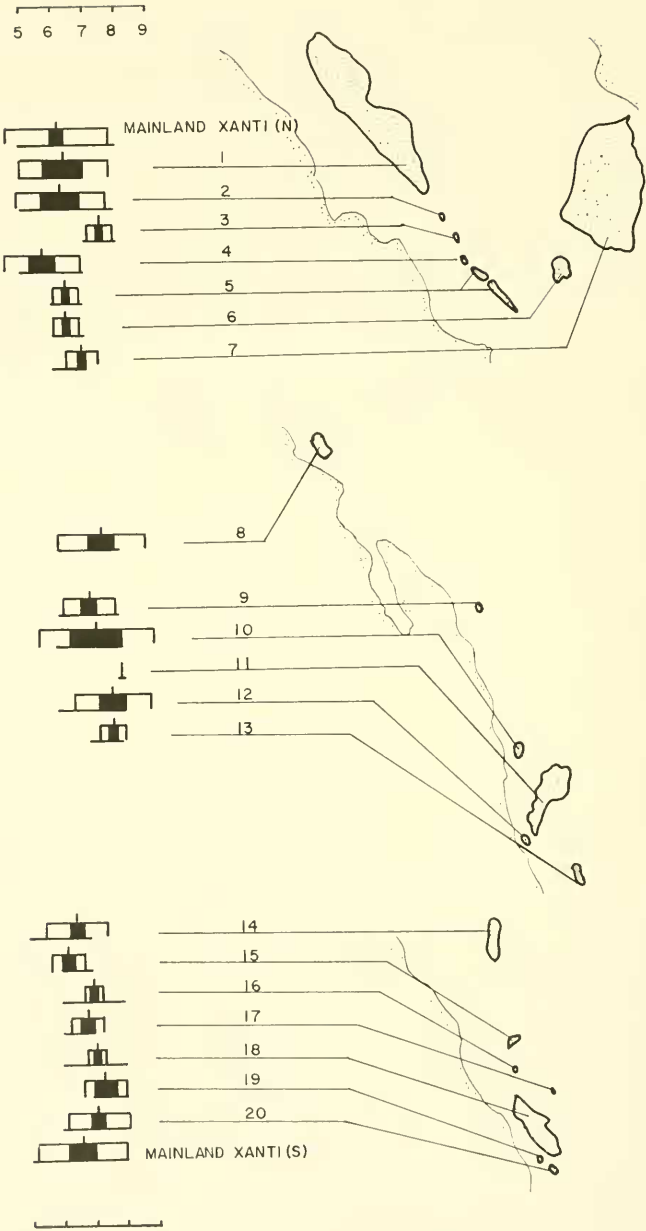


FIGURE 10. Variation in the number of scales bordering the internasals posteriorly (see figure 3 for explanation of analysis).

***Phyllodactylus xanti estebanensis* Dixon, new subspecies.**

HOLOTYPE. Adult ♂, CAS no. 98481, collected by James R. Dixon and Donald W. Tinkle on Granite Boulders, August 14, 1964; on Isla San Esteban, Baja California.

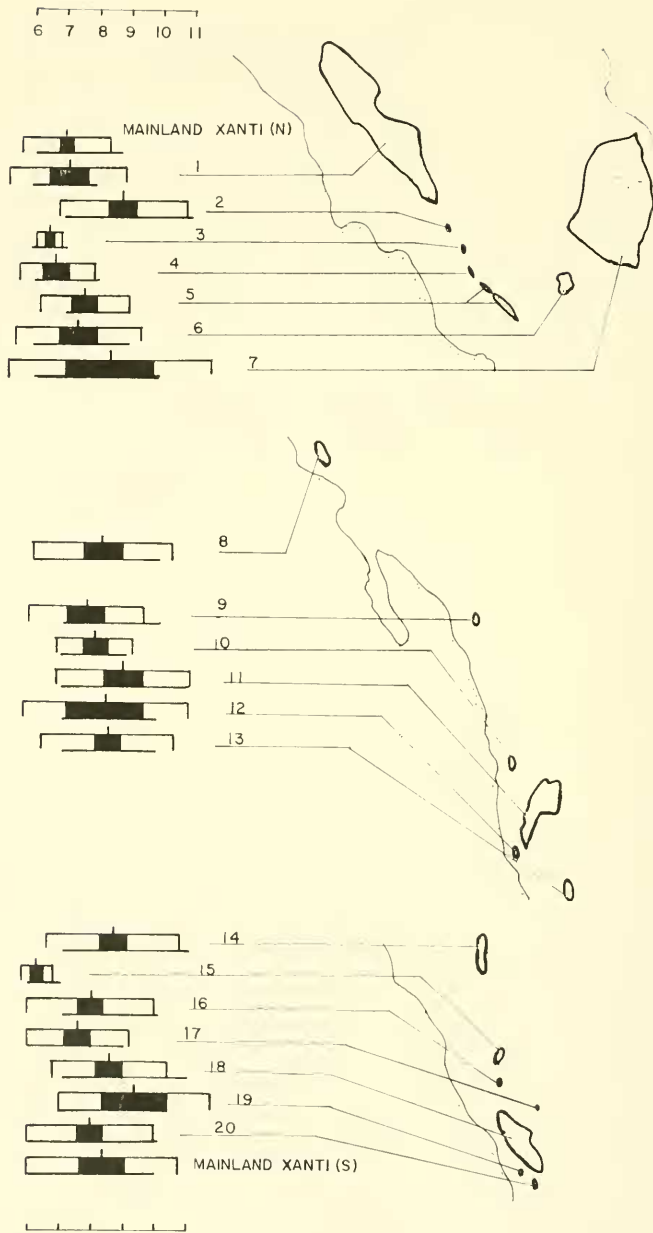
PARATYPES. San Esteban: CAS 50798, 84889-91, 98482-83; MCZ 82867; UCLA 15000-02; SDMNH 50870-71. Tiburon: CAS 98544-46; SDMNH 50852-53. Pelicano: BT 139 (Museum unknown).

DIAGNOSIS: Average snout-vent length of 42.9 mm., differing from mainland races in having a much darker color pattern and a lower number of ventral scales and tubercles in a paravertebral row, and differing also from adjacent insular races in having a lower number of tubercles in a paravertebral row and scales across the belly.

DESCRIPTION OF HOLOTYPE. Rostral twice as wide as high, its dorsal edge with a slight depression and a short median vertical groove; 2 internasals, rounded, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side. nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in narrow contact with ventral edge of nostril; shallow depression between eye and nostril. scales in posterior loreal region about 6 to 7 times larger than scales in midorbital region; 15 scales across snout at level of third labials, 15 scales at anterior edge of orbits, 19 interorbital scales; eye large, its diameter contained in length of snout one and one-half times; eyelid with 2 rows of granules and one larger outer row of scales; diameter of ear contained in eye diameter two times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 7 supralabials and 6 infralabials to a point below center of eye; mental bell-shaped, wider than long; bordered posteriorly by 2 postmentals; postmental longer than wide, their median edges in broad contact, postmentals followed by transverse row of 8 scales, followed by second row of 12 smaller scales; postmentals contact first and second labials on each side.

Dorsum with 14 longitudinal rows of enlarged keeled tubercles that are somewhat flat; paravertebral row with 38 tubercles from rear of head to base of tail, 21 between axilla and groin; paravertebral rows separated from each other by 5 to 6 rows of granules; 8 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 2 on each side, distinct; venter with 61 longitudinal and 31 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with 4 to 5 tubercles dispersed among the smaller flattened scales, lower leg with several tubercles interspersed among the granular scales; lamellae formula for hand 9-10-10-9-7, foot 9-11-12-13-11; claw moderate, visible when viewed from below; terminal pad large, slightly longer than wide, truncate at



SCALES BORDERING THE POSTMENTALS

FIGURE 11. Variation in the number of scales bordering the postmentals posteriorly (see figure 3 for explanation of analysis).

tips; tail tubercular rows reduced to zero on the 3rd proximal whorl of the tail.

MEASUREMENTS (in mm.). Snout-vent length 49, axilla-groin length 22, length of leg 19, length of arm 15, length of tail (one half missing), length of head 14.5, width of head 9.5, length of snout 6.0; diameter of eye 4.0 diameter of ear 2.0.

COLOR IN LIFE. Ground color tan with some darker flecks of chocolate brown intermixed; six chocolate brown dorsal bands, extending only across dorsal portion of back, broken into spots along sides; head reticulated with chocolate brown lines, darker color predominating over ground color; chocolate brown stripe from nostril, through eye to ear; dorsal surfaces of limbs similar, but not as distinctly marked; ventral surfaces of tail, belly, and limbs cream white, ventral surfaces of feet brownish.

RANGE. Islas San Esteban and Tiburon, Gulf of California.

SPECIES EXAMINED. (15), listed under type and paratypes.

Phyllodactylus xanti circus Dixon, new subspecies.

HOLOTYPE. Adult ♀, SDMNH no. 50814, collected by Charles E. Shaw, April 2, 1962, from Isla Ildefonso, Baja California.

PARATYPES. Ildefonso: CAS 51754-55, 84878; SDMNH 50809-12, 50815-17.

DIAGNOSIS. Average snout-vent length of 46.4 mm., differing from mainland races in having fewer tubercles in a paravertebral row; fewer interorbital scales, and rows of enlarged dorsal tubercles; from adjacent insular races in having fewer tubercles in a paravertebral row from head to tail and axilla to groin.

DESCRIPTION OF HOLOTYPE. Rostral twice as wide as high, its dorsal edge forming a low "w" from a frontal view; 2 internasals, rounded posteriorly, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial barely in contact with ventral edge of nostril; shallow depression between internasals, slight depression in frontal region; 10 scales between eye and nostril, scales in posterior loreal region about 3 to 4 times larger than scales in midorbital region; 16 scales across snout at level of third labials, 14 scales at anterior edge of orbits, 19 interorbital scales; eye large, its diameter contained in length of snout almost 2 times; eyelid with 1 row of granules and 1 larger outer row of scales; diameter of ear contained in eye diameter slightly less than 2 times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 7 supralabials and 6 intralabials to a point below center of eye; mental bell-shaped, longer than wide; bordered posteriorly by 2 postmentals; postmentals wider than long, their median edges in narrow contact, postmentals followed by transverse row of 10 scales, followed by second row of 13 smaller scales; postmentals contact only the first labial of each side.

Dorsum with 12 longitudinal rows of enlarged, keeled tubercles that are

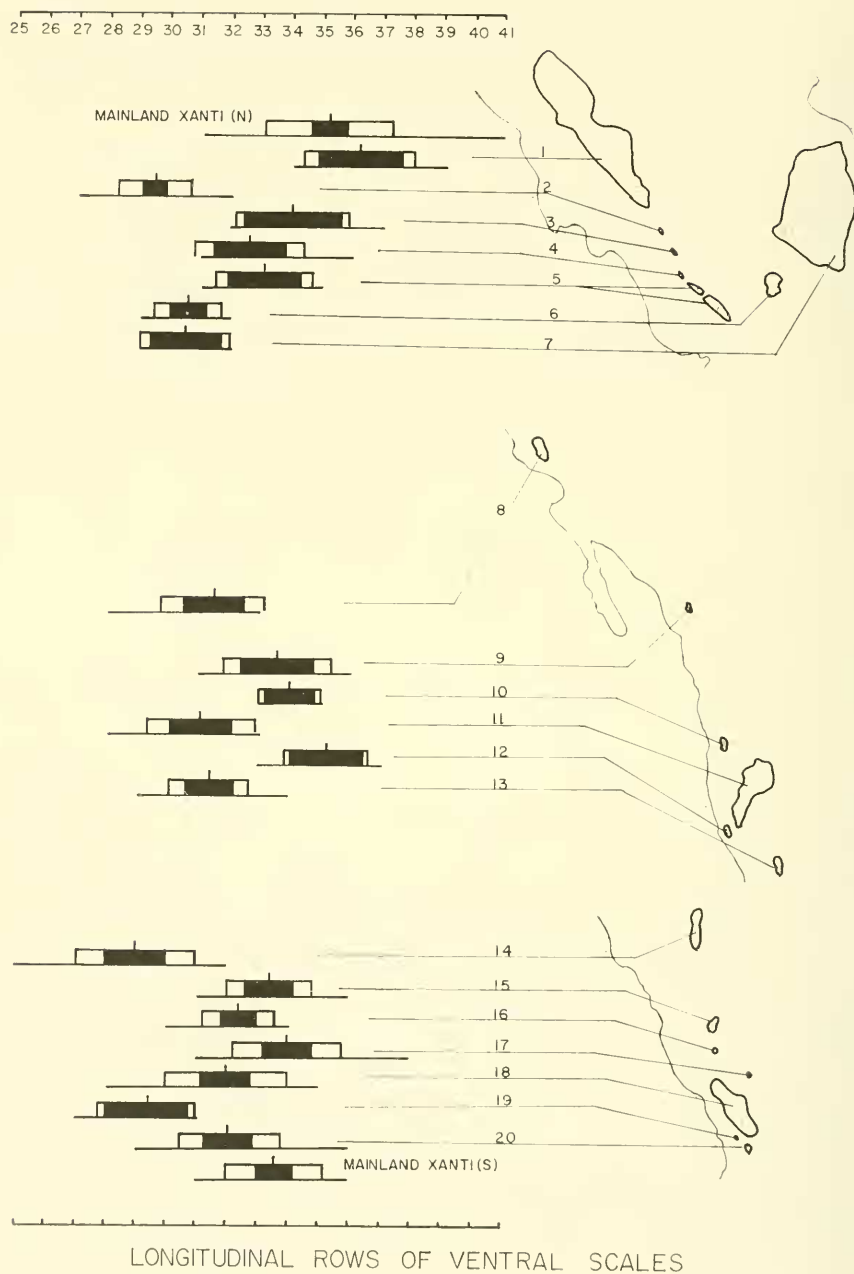


FIGURE 12. Variation in the number of longitudinal rows of ventral scales (see figure 3 for explanation of analysis).

somewhat flat; paravertebral row with 35 tubercles from rear of head to base of tail, 19 between axilla and groin; paravertebral rows separated from each other by 5 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 3 on each side, distinct; venter with 58 longitudinal and 35 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with three to four tubercles dispersed among the smaller flattened scales, lower leg with a few tubercles interspersed among the granular scales; lamellae formula for hand 7-9-10-11-9, foot 6-8-10-13-10; claw short, visible when viewed from below; terminal pad large, slightly truncate at tip; tail tubercular rows reduced to zero on the 3rd proximal whorl of the tail.

MEASUREMENTS (in mm.). Snout-vent length 47, axilla-groin length 22, length of leg 19, length of arm 17, length of tail (part missing), length of head 15, width of head 10, length of snout 6; diameter of eye 3.5, diameter of ear 2.0.

COLOR IN ALCOHOL. Ground color light brown; dorsum with five irregular crossbands of dark brown; dorsolateral areas of body reticulated with dark brown; limbs heavily spotted with dark brown; head reticulated with brownish lines; brownish loreal stripe from nostril to eye; tail with narrow brown crossbands, brown bands one-half the width of light interspaces. Venter cream yellow to dusky.

RANGE. Isla San Ildefonso, Gulf of California.

SPECIMENS EXAMINED. (11), listed under type and paratypes.

Phyllodactylus xanti coronatus Dixon, new subspecies.

HOLOTYPE. Adult ♀, CAS no. 51803, collected by Joseph R. Slevin, May 18, 1921, from Isla Coronados, Baja California.

PARATYPES. Coronados: CAS 51802, 51804-07.

DIAGNOSIS. Average snout-vent length of 47.4 mm., differing from adjacent insular races in having a higher number of interorbitals, belly scales, paravertebral tubercles, and a lower number of snout scales; from mainland races in having a higher number of interorbitals, scales between eye and nostril and intermediate in number of snout scales.

DESCRIPTION OF HOLOTYPE. Rostral twice as wide as high, its dorsal edge with 2 internasals, rounded, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in contact with ventral edge of nostril; shallow depression between internasals, moderate depression in frontal region; 11 scales between eye and nostril; scales in posterior loreal region about 5 to 6 times larger than scales in midorbital region; 17 scales across snout at level of third labials, 23 interorbital scales; eye large, its diameter contained in length of snout one and one-third times; eyelid with 2 rows of

granules and 1 larger outer row of scales; diameter of ear contained in eye diameter one and one-third times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 6 supralabials and 6 infralabials to a point below center of eye; mental bell-shaped, as wide as long; bordered posteriorly by 2 postmentals; postmental longer than wide, their median edges in broad contact, followed by transverse row of 8 scales, followed by second row of 14 smaller scales; postmentals contact only first labial of each side.

Dorsum with 14 longitudinal rows of enlarged, keeled tubercles that are somewhat flat, paravertebral row with 36 tubercles from rear of head to base of tail, 19 between axilla and groin; paravertebral rows separated from each other by 5 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 1 on each side, indistinct, venter with 63 longitudinal and 33 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with two to four tubercles dispersed among the smaller flattened scales, lower leg with several tubercles interspersed among the granular scales; lamellae formula for hand 6-8-10-11-9, foot 6-9-11-13-10; claw short, visible when viewed from below; terminal pad large, slightly longer than wide. Tail tubercular row reduction to zero occurs on the first proximal whorl of tail.

MEASUREMENTS (in mm.). Snout-vent length 52, axilla-groin length 23, length of leg 21, length of arm 16, length of tail (regenerated), length of head 15.5, width of head 10.0, length of snout 5.5; diameter of eye 3.6, diameter of ear 2.2.

COLOR IN ALCOHOL. Ground color grayish brown, dorsal pattern of six alternating pairs of brown spots, almost meeting across dorsum; head with brownish irregular lines, brown loreal stripe from nostril to eye, moderately distinct; limbs faintly marked with brown; venter brownish; tail light brown, regenerated.

RANGE. Isla Coronados, Gulf of California.

SPECIMENS EXAMINED. (6), listed under type and paratypes.

Phyllodactylus xanti acorius Dixon, new subspecies.

HOLOTYPE. Adult ♂, CAS no. 98451, collected by James R. Dixon from a granite slab, August 9, 1964, from Isla San Diego, Baja California.

PARATYPES. San Diego: CAS 52478-80, 98452-58, 98460-62; MCZ 82865; SDMNH 50827-29.

DIAGNOSIS. Average snout-vent length of 41.2 mm., differing from mainland races in having a higher number of interorbitals, paravertebral tubercles, and rows of dorsal tubercles, a fewer number of ventral scales; from adjacent insular races in having a higher number of interorbitals, paravertebral tubercles, and vertebral tubercles.

DESCRIPTION OF HOLOTYPE. Rostral two and one-half times as wide as high, its dorsal edge with a short, vertical, median groove; 2 internasals, rounded posteriorly, their median edges in broad contact, bordered posteriorly by 5 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in narrow contact with ventral edge of nostril; shallow depression between internasals, shallow depression in frontal region; 11 scales between eye and nostril, scales in posterior loreal region about 4 to 5 times larger than scales in midorbital region; 17 scales across snout at level of third labials, 15 scales at anterior edge of orbits, 19 interorbital scales; eye large, its diameter contained in length of snout one and one-third times; eyelid with 2 rows of granules and 1 larger outer row of scales; diameter of ear contained in eye diameter two and one-fourth times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 7 supralabials and 6 infra-labials to a point below center of eye; mental bell-shaped, and as wide as long; their median edges in narrow contact, postmentals followed by transverse row of 8 scales, followed by second row of 12 smaller scales; postmentals contact only the first labial on each side.

Dorsum with 16 longitudinal rows of enlarged, keeled tubercles that are somewhat flat, paravertebral row with 36 tubercles from rear of head to base of tail, 19 between axilla and groin; paravertebral rows separated from each other by 5 rows of granules; 8 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 3 on each side, distinct; venter with 51 longitudinal and 32 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with five to six tubercles dispersed among the smaller flattened scales, lower leg with several tubercles interspersed among the granular scales; lamellae formula for hand 6-8-10-11-10; foot 6-9-11-12-10; claw moderate, visible when viewed from below; terminal pad large, slightly truncate at tips; tail tubercular reduction to zero at the fifth proximal tail whorl.

MEASUREMENTS (in mm.). Snout-vent length 46, axilla-groin length 21, length of leg 17, length of arm 14, length of tail (part missing), length of head 14, width of head 9, length of snout 5; diameter of eye 3.5, diameter of ear 1.5.

COLOR IN ALCOHOL. Ground color grayish tan; dorsum with an alternating series of small brown spots positioned along each paravertebral row of tubercles; limbs with faint or diffuse brown spots, head minutely spotted with brown; loreal stripe dark brown, short, from mid-snout to eye; tail faintly banded, with grayish brown; venter cream to white.

RANGE. Isla San Diego, Gulf of California.

SPECIMENS EXAMINED. (18), listed under type and paratypes.

Phyllodactylus angelensis Dixon, new species.

HOLOTYPE. Adult ♂, SDMNH no. 19996, collected by Allan J. Sloan, March 22, 1963, from the north end of Isla Angel de la Guarda, Baja California.

PARATYPES. Angel de la Guarda: CAS 50905-07, 98543; Isla Pond: SDMNH 50851.

DIAGNOSIS. Average snout-vent length of 45.5 mm., differing from adjacent insular and mainland species in having a low number of rows of enlarged dorsal tubercles, a high number of longitudinal belly scales and tubercles in a paravertebral row from head to tail, and an intermediate number of snout scales, lamellae beneath the fourth toe, and scales between eye and nostril.

DESCRIPTION OF HOLOTYPE. Rostral almost twice as wide as high, its dorsal edge with slight depression and short, vertical, median groove; internasals rectangular, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in narrow contact with ventral edge of nostril; shallow depression between internasals, moderate depression in frontal region; 12 scales between eye and nostril, scales in posterior loreal region about 4 to 5 times larger than scales in midorbital region; 18 scales across snout at level of third labials, 15 scales at anterior edge of orbits, 23 interorbital scales; eye large, its diameter contained in length of snout one and one-half times; eyelid with 2 rows of granules and one larger outer row of scales; diameter of ear contained in eye diameter 2 times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 7 supralabials and 6 infralabials to a point below center of eye; mental bell-shaped, longer than wide; bordered posteriorly by 2 postmentals; postmentals wider than long, their median edges in narrow contact, postmentals followed by transverse row of 8 scales, followed by second row of 14 smaller scales; postmentals contact only the first labial on each side.

Dorsum with 12 longitudinal rows of enlarged, keeled tubercles that are somewhat flat; paravertebral row with 42 tubercles from rear of head to base of tail, 26 between axilla and groin; paravertebral rows separated from each other by 6 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 3 on each side, distinct; venter with 62 longitudinal and 36 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh without tubercles dispersed among the smaller flattened scales, lower leg with a few tubercles interspersed among the granular scales; lamellae formula for hand 6-9-10-11-10, foot 7-9-13-14-12; claw short, visible when viewed from below; terminal pad large, slightly longer than wide. Tail tubercular rows reduced to zero on the third proximal whorl of tail.

MEASUREMENTS (in mm.). Snout-vent length 52, axilla-groin length 24, length of leg 23, length of arm 18, length of tail (half of tail missing), length of head 16, width of head 11, length of snout 6; diameter of eye 4, diameter of ear 2.

COLOR IN ALCOHOL. Ground color tan, dorsum with six brown crossbands, broken along the midline, slightly irregular in shape; head reticulated with dark brown; loreal stripe indistinct; limbs with diffuse brownish spots; distal one-half of tail missing, proximal half banded with brown and interspaces of ground color.

RANGE. Isla Angel de la Guarda, Gulf of California.

SPECIMENS EXAMINED. (7), listed under type and paratypes.

***Phyllodactylus partitus* Dixon, new species.**

HOLOTYPE. Adult ♂, CAS no. 98429, collected by James R. Dixon and Donald W. Tinkle on a rubble beach; August 18, 1964, on Isla Partida (N.), Baja California.

PARATYPES. Partida (N.): CAS 98430-50; LMK 6834-36, 39258, 39649, 40508; MCZ 13411; AHF-USC 50; SDMNH 50820-22.

DIAGNOSIS. A large gecko, average snout-vent length 53.3 mm., differing from all other insular forms in having a combination of a high number of snout scales and a low number of tubercles in a paravertebral row from rear of head to base of tail.

DESCRIPTION OF HOLOTYPE. Rostral twice as wide as high, its dorsal edge with a slight depression and a short median groove; internasals, rectangular, their median edges in broad contact, bordered posteriorly by 3 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in broad contact with ventral edge of nostril; shallow depression between internasals, deep depression in frontal region; 13 scales between eye and nostril, scales in posterior loreal region about 2 to 3 times larger than scales in midorbital region; 25 scales across snout at level of third labials, 15 scales at anterior edge of orbits, 18 interorbital scales; eye large, its diameter contained in length of snout almost 2 times; eyelid with 3 rows of granules and one larger outer row of scales, last few without spines; diameter of ear contained in eye diameter slightly less than 2 times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 6 supralabials and 5 infralabials to a point below center of eye; mental bell-shaped, longer than wide; bordered posteriorly by 2 postmentals; postmentals wider than long, their median edges in narrow contact, postmentals followed by transverse row of 9 scales, followed by second row of 12 smaller scales; postmentals contact first labial on right, and first and second on left side.

Dorsum with 14 longitudinal rows of enlarged, keeled tubercles that are somewhat flat; paravertebral row with 38 tubercles from rear of head to base

of tail, 23 between axilla and groin; paravertebral rows separated from each other by 6 to 8 rows of granules; 6 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 4 on each side, distinct; venter with 61 longitudinal and 30 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with 5 to 6 tubercles dispersed among the smaller flattened scales, lower leg with many tubercles interspersed among the granular scales; lamellae formula for hand 8-10-11-12-8, foot 8-10-11-14-10; claw short, visible when viewed from below; terminal pad large, slightly longer than wide. Tail with a 6-4-2 reduction in tubercular rows; reduced to two for one-third length of the tail (in topotypes).

MEASUREMENTS (in mm.). Snout-vent length 59, axilla-groin length 28, length of leg 23, length of arm 18, length of tail (missing), length of head 17.5, width of head 12, length of snout 7; diameter of eye 4, diameter of ear 2.5.

COLOR IN LIFE. Ground color brown, dorsum with eight chocolate brown crossbands that are interrupted along the median line; interspaces brown, and very narrow, mid-dorsal line obscure but lighter in color than interspaces; limbs heavily pigmented with chocolate brown, banding obscure; dorsal surfaces of hands and feet brownish; head dark brown, any other marks about head obscured by the dark ground color; tail more conspicuously marked with light and dark bands; venter cream yellow.

RANGE. Isla Partida (North), Gulf of California.

SPECIMENS EXAMINED. (34), listed under type and paratypes.

***Phyllodactylus tinklei* Dixon, new species.**

HOLOTYPE. Adult ♂, CAS no. 98463, collected by Donald W. Tinkle, from beneath a lava rock; August 19, 1964, on Isla Raza, Baja California.

PARATYPES. Raza; CAS 51114, 98464-66; MCZ 82864.

DIAGNOSIS. A medium-sized gecko, average snout-vent length of 47.5 mm., differing from all other insular forms in having each tubercle of each row white tipped, giving an appearance of many white lines on the body; and an incomplete white bar across the rear of the head; this species also has a high number of scales bordering the internasals and lamellae beneath the fourth toe.

DESCRIPTION OF HOLOTYPE. Rostral about two and one-half times as wide as high, its dorsal edge with slight depression and a short median groove; 2 internasals, rounded, their median edges in narrow contact, bordered posteriorly by 6 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in very narrow contact with ventral edge of nostril; shallow depression between internasals, slight depression in frontal region; 12 scales between eye and nostril, scales in posterior loreal region

about 5 to 6 times larger than scales in midorbital region; 16 scales across snout at level of third labials, 16 scales at anterior edge of orbits, 22 interorbital scales; eye large, its diameter contained in length of snout one and one-half times; eyelid with 2 rows of granules and one larger outer row of scales, last 5 to 6 without soft spines; diameter of ear contained in eye diameter about one and one-half times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 8 supralabials and 7 infralabials to a point below center of eye; mental bell-shaped, as wide as long; bordered posteriorly by 2 postmentals; postmentals longer than wide, their median edges in broad contact, postmentals followed by transverse row of 7 scales, followed by second row of 13 smaller scales; postmentals contact first and second labials on each side.

Dorsum with 14 longitudinal rows of enlarged, keeled tubercles that are somewhat flat, paravertebral row with 38 tubercles from rear of head to base of tail, 22 between axilla and groin; paravertebral rows separated from each other by 5 to 7 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 4 on each side, distinct; venter with 63 longitudinal and 32 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh without tubercles dispersed among the smaller flattened scales, lower leg with several tubercles interspersed among the granular scales; lamellae formula for hand 7-9-10-11-9, foot 6-9-13-14-11; claw short, visible when viewed from below; terminal pad large, slightly longer than wide. Tail tubercular rows reduced from 4 to 0 in the proximal 3 whorls of tail.

MEASUREMENTS (in mm.). Snout-vent length 52, axilla-groin length 24, length of leg 21, length of arm 17, length of tail 57, length of head 15.2, width of head 10, length of snout 5.5; diameter of eye 3.5, diameter of ear 2.2.

COLOR IN LIFE. Ground color brownish tan; dorsum with five obscure brownish bands; some interrupted medially; each tubercle of enlarged series of dorsum tipped with white; head brownish, white line from rear of eye curving upward and posteriorly towards parietals, almost forming a complete loop across the rear of head; loreal stripe obscure; limbs brownish with banding obscure; tail is distinctly banded with gray and darker brownish black bands; venter cream or white, lateral areas with a slight yellow cast.

RANGE. Isla Raza, Gulf of California.

SPECIMENS EXAMINED. (6), listed under type and paratypes.

Phyllodactylus bugastrolepis Dixon, new species.

HOLOTYPE. Adult ♀, CAS no. 98485, collected by James R. Dixon under the bark of a Palo Verde, August 11, 1964, on Isla Catalina, Baja California.

PARATYPES. Catalina: CAS 98486-90, 98492-95, 52340; MCZ 82862; SDMNH 44604-07, 44611-13, 50792-93.

DIAGNOSIS. A small gecko, average snout-vent length of 45.1 mm., with exceptionally large belly scales that are few in number from gular region to anus; and in rows across the belly; a general pallid appearance in color pattern and color.

DESCRIPTION OF HOLOTYPE. Rostral slightly more than twice as wide as high, its dorsal edge with slight depression; and a short median groove; 2 internasals, rectangular, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in narrow contact with ventral edge of nostril; shallow depression between internasals, moderate depression in frontal region; 10 scales between eye and nostril, scales in posterior loreal region about 4 to 5 times larger than scales in midorbital region; 20 scales across snout at level of third labials, 16 scales at anterior edge of orbits, 23 interorbital scales; eye large, its diameter contained in length of snout almost 2 times; eyelid with 2 rows of granules and 1 larger outer row of scales, without soft spines; diameter of ear contained in eye diameter two and one-fourth times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 6 supralabials and 5 infralabials to a point below center of eye; mental bell-shaped, wider than long; bordered posteriorly by 2 postmentals; postmentals longer than wide, their median edges in narrow contact, followed by transverse row of 8 scales, followed by second row of 12 smaller scales; postmentals contact only the first labial on each side.

Dorsum with 15 longitudinal rows of enlarged, keeled tubercles that are somewhat flat; paravertebral row with 39 tubercles from rear of head to base of tail, 23 between axilla and groin; paravertebral rows separated from each other by 5 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 2 on each side, indistinct; venter with 48 longitudinal and 29 transverse rows of scales, ventral scales about 16 times larger than mid-dorsal granules.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh with 2 to 3 tubercles dispersed among the smaller flattened scales, lower leg with many tubercles interspersed among the granular scales; lamellae formula for hand 7-8-10-10-9, foot 7-9-12-14-10; claw short, visible when viewed from below; terminal pad large, slightly longer than wide. Tail with a 4-2-0 reduction in tubercles on the proximal 3 whorls.

MEASUREMENTS (in mm.). Snout-vent length 49, axilla-groin length 22, length of leg 19, length of arm 14, length of tail 39, length of head 15, width of head 10.5, length of snout 6; diameter of eye 3.5, diameter of ear 1.5.

COLOR IN ALCOHOL. Ground color brownish gray; dorsum with scattered small, dark brown spots; limbs faintly spotted with brown; head faintly spotted with minute brown flecks; brown loreal stripe from nostril to ear; tail with faint banding above, slate below; venter flesh to cream.

RANGE. Isla Santa Catalina, Gulf of California.

SPECIMENS EXAMINED. (26), listed under type and paratypes.

Phyllodactylus santacruzensis Dixon, new species.

HOLOTYPE. Adult ♀, CAS no. 98468, collected by James R. Dixon, from beneath an exfoliating granite slab, August 9, 1964, from Isla Santa Cruz, Baja California.

PARATYPES. Santa Cruz: CAS 52390, 98469-73, 98475-76; MCZ 82863; SDMNH 50872-73.

DIAGNOSIS. Average snout-vent length of 47.5 mm., differing from all other species of the *xanti* complex in having a significantly higher number of paravertebral tubercles, and lower number of scales bordering the postmentals.

DESCRIPTION OF HOLOTYPE. Rostral almost twice as wide as high, its dorsal edge with a slight depression, and a short median groove; internasals, somewhat rectangular, their median edges in broad contact, bordered posteriorly by 4 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in broad contact with ventral edge of nostril; shallow depression between internasals, slight depression in frontal region; 12 scales between eye and nostril, scales in posterior loreal region about 5 to 6 times larger than scales in midorbital region; 19 scales across snout at level of third labials, 16 scales at anterior edge of orbits, 21 interorbital scales; eye large, its diameter contained in length of snout one and three-fourths times; eyelid with 2 rows of granules and one larger outer row of scales; diameter of ear contained in eye diameter 2 times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear of head granular with many larger intermixed tubercles; 8 supralabials and 5 infralabials to a point below center of eye; mental bell-shaped, longer than wide; bordered posteriorly by 2 postmentals; postmentals longer than wide, their median edges in broad contact, postmentals followed by transverse row of 6 scales, followed by second row of 11 smaller scales; postmentals contact first labial on right, first and second labials on left side.

Dorsum with 15 longitudinal rows of enlarged, keeled tubercles that are somewhat flat; paravertebral row with 44 tubercles from rear of head to base of tail, 25 between axilla and groin; paravertebral rows separated from each other by 5 to 6 rows of granules; 8 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 3 on each side, distinct; venter with 57 longitudinal and 34 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tuber-

cles interspersed among the smaller flattened scales; dorsal surface of thigh with 3 to 4 tubercles dispersed among the smaller flattened scales, lower leg with several tubercles interspersed among the granular scales; lamella formula for hand 8-9-9-11-9, foot 7-9-13-14-11; claw moderate, visible when viewed from below; terminal pad large, slightly longer than wide. Tail tubercular rows reduced to zero by the third proximal whorl of tail.

MEASUREMENTS (in mm.). Snout-vent length 51, axilla-groin length 24, length of leg 21, length of arm 17, length of tail 46, length of head 16, width of head 11, length of snout 7; diameter of eye 4, diameter of ear 2.

COLOR IN ALCOHOL. Ground color light gray; dorsum with four brownish black linear stripes broken into a series of three to six linear spots; arm with longitudinal blackish reticulations; leg faintly spotted with brown; tail very spotty with dark brown, head with brownish reticulations from nostril to mid-orbital region; rear of head spotted with brown; dark loreal stripe from nostril to ear; venter white or cream.

RANGE. Isla Santa Cruz, Gulf of California.

SPECIMENS EXAMINED. (12), listed under type and paratypes.

Phyllodactylus apricus Dixon, new species.

HOLOTYPE. Adult ♂, SDMNH no. 44623, collected by Chris Parrish and G. E. Lindsay, June 27, 1964, from Isla Las Animas, Baja California.

PARATYPES. Las Animas: SDMNH 44620-22, 44624, 50830-42, 50844-49.

DIAGNOSIS. Average snout-vent length of 48.7 mm., differing from *P. xanti* of Isla San Jose, having a significantly higher number of ventral scales, dorsal tubercle rows, paravertebral tubercles, and lower number of interorbitals, snout scales, and scales bordering the postmentals; from *P. bugastrolepis* in having a higher number of ventral scales and lower number of snout scales, interorbitals, dorsal tubercle rows, paravertebral tubercles, and scales bordering the postmentals.

DESCRIPTION OF HOLOTYPE. Rostral almost twice as wide as high, its dorsal edge with slight median groove; internasals, rounded posteriorly, their median edges in broad contact, bordered posteriorly by 7 granules and postnasal of each side, nostril surrounded by rostral, labial, internasal, and 2 postnasals. First supralabial in broad contact with ventral edge of nostril; shallow depression between internasals, moderate depression in frontal region; 11 scales between eye and nostril, scales in posterior loreal region about 5 to 6 times larger than scales in midorbital region; 19 scales across snout at level of third labials, 18 scales at anterior edge of orbits, 21 interorbital scales; eye large, its diameter contained in length of snout one and one-half times; eyelid with one row of granules and one larger outer row of scales, last 4 to 5 of which are not pointed; diameter of ear contained in eye diameter two and one-fourth times, ear opening not denticulate, scales on anterior and posterior edges rounded, subequal; rear

of head granular with many larger intermixed tubercles; 6 supralabials and 5 infralabials to a point below center of eye; mental bell-shaped, slightly wider than long, bordered posteriorly by 2 postmentals; postmentals longer than wide, their median edges in broad contact, followed by transverse row of 8 scales, followed by second row of 11 smaller scales; postmentals contact first labial on right side, first and second labial on left side.

Dorsum with 14 longitudinal rows of enlarged, keeled tubercles that are somewhat flat, paravertebral row with 40 tubercles from rear of head to base of tail, 22 between axilla and groin; paravertebral rows separated from each other by 4 rows of granules; 10 rows of tubercles reach to rear of head, 6 to base of tail; each tubercle of enlarged dorsal series separated from preceding tubercle by 1 to 2 granules; postanal tubercles number 2 on each side, indistinct; venter with 62 longitudinal and 38 transverse rows of scales.

Dorsal surface of upper arm with flattened scales, forearm with larger tubercles interspersed among the smaller flattened scales; dorsal surface of thigh without tubercles dispersed among the small flattened scales, lower leg with 2 to 3 tubercles interspersed among the granular scales; lamellae formula for hand 7-9-10-11-10, foot 7-11-13-14-11; claw short, visible when viewed from below; terminal pad large, slightly wider than long. Tail with 4-2-0 reduction of tubercle rows on proximal two whorls of tail.

MEASUREMENTS (in mm.). Snout-vent length 50, axilla-groin length 24, length of leg 19, length of arm 16, length of tail 47, length of head 15, width of head 10, length of snout 5; diameter of eye 3.5, diameter of ear 1.5.

COLOR IN ALCOHOL. Ground color brownish tan; dorsum with four bands, interrupted medially, dark brown; and generally diffuse in appearance; each enlarged dorsal tubercle white tipped; upper arm with faint diffuse brownish bands, thigh similar to dorsum; spots more diffuse, tail brownish gray, with scattered darker flecks; head slightly darker than dorsum; with scattered diffuse dark brown spots; diffuse brown line from nostril to eye; ventral surfaces with each scale whitish posteriorly, dusky otherwise, with a few scattered black dots in each scale.

RANGE. Isla Las Animas, Gulf of California.

SPECIMENS EXAMINED. (24), listed under type and paratypes.

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